Study and Analysis of Viscous Flow with Reynolds Number less than 0.1

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Abstract

In the current article the circulation of an incompressible fluid is a point of examination. The fluid flows over the obstruction in a channel. The channel fluid flow is restrained using a bar. The bar which is posing restriction in the flow is taken of square cross section. The velocity in x-y direction has been studied with the help of a computer program.

Keywords: *Viscous, Velocity vector, Reynolds Number, Restriction, inertia.*

1. Introduction

Suzuki.et.al.1993 studied laminar channel flow. Obstruction was placed in the channel. Obstruction was a rod of square cross section. The rod was placed in a perpendicular direction to the flow. The size of the rod varied and the computational results were studied. Also the study was conducted for different value of ratio of inertia force to viscous force. Study was made regarding the coefficient of drag and frequency of whirl shedding. Also the pattern of street that was formed in the rod downstream was analyzed. The motion which was in the form of criss and cross has been discussed in detail. The reason behind this type of motion of vortices was found in the form of blockage ratio.

Chakraborty,J. et.al.2004 examined the flow of steady nature using fluent. The fluid was taken as incompressible and follows the viscosity law of Newton's. The obstruction was taken in the form of a circular cylinder. As far as boundary conditions are concerned the flow at inlet was taken as uniform flow. The value of ratio of inertia force to viscous force varied from 0.1 to 200. Also the ratio of width of channel and diameter of cylinder varied between 1.54 and 20. All the parameters were taken in the form of Reynolds number and blockage ratio. From the results it was analyzed that when Reynolds number is taken as constant, then coefficient of drag decreases with upsurge in blockage ratio. Also if ratio of width of channel and diameter of cylinder is taken as constant then with the upsurge in Reynolds number, drag coefficient decreases. Also with advancement in Reynolds number separation angle and zonal length of recirculation increases.

Balint,T.S.,& Lucey A.D.,2005 conducted a study in case of a channel in which the flow was taken as viscous. The plate in the form of cantilever and flexible was taken to check the stability of upside airway in the humans. The plate was responsible for the obstruction of airway at the time of sleep. Finite differences were used to solve the navior stokes equation. The maximum value of Reynolds number was taken as 1500. The analysis was based on two dimensional problems. It was observed that there was a loss in the stability of plate when airways are not closed on the upside and lower side. At this stage critical Reynolds number comes into picture. Also the plate is found to lose its stability when one of the ways of air is not open. The mechanism responsible for this was mechanism of divergence. At this stage flow speed which is critical comes into picture. This type of study will serve the purpose of solving the disorders of way of air in the upper side**.**

Afrouzi, A.H.et.al.2015 investigated the presence of particles of micro size in a channel. The study was focused when there was obstruction in the form of square cross section. At the inlet pulsation of flow was taken. The numerical study was done using two different methods. First method was Euler's method and the second one was Boltzmann method. These two methods were used for the simulation of flow field and to determine the trajectories of particles. The equation of motion of particles consists of different forces. These forces are drag force, lift force and force of gravity. The dispersion of particles and efficiency of deposition were studied as a

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function of amplitude of pulsation and stokes number. From the results it was predicted that the vortices are formed near to the obstruction. And this was due to increase in the amplitude of pulsation. This continues unless and until there is depreciation in shape.

Kumar, D.2014 analyzed the fluid flow in two dimensions in case of a channel. In the channel obstruction was provided. The flow was considered to be steady and independent of time. The variation of pressure was seen with ratio of inertia force to viscous force. Also the pattern of streamlines was studied.

Kumar, D. & Malik, R.K.,2015 studied the flow using navier equations in 2D. A computer program was used to solve the problem. The region of low pressure and high pressure in case an obstruction was studied.

Kumar, D.2016, used the Flex pde for the solution of the continuity, momentum equation and energy equation in case of a fluid flow with certain obstruction. The fluid was taken as incompressible.

2. Results

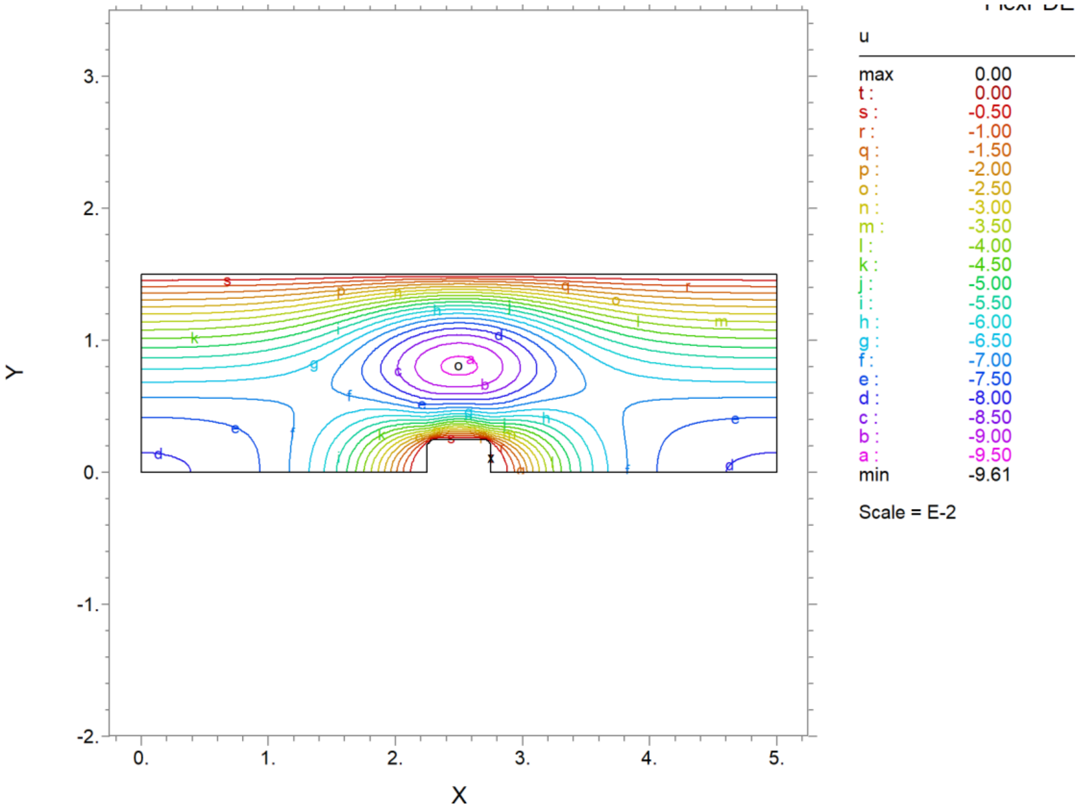

Figure 1. Velocity in X- Direction.

The above Figure depicts the alteration of velocity in horizontal direction in the flow of an incompressible fluid with low Reynolds number.

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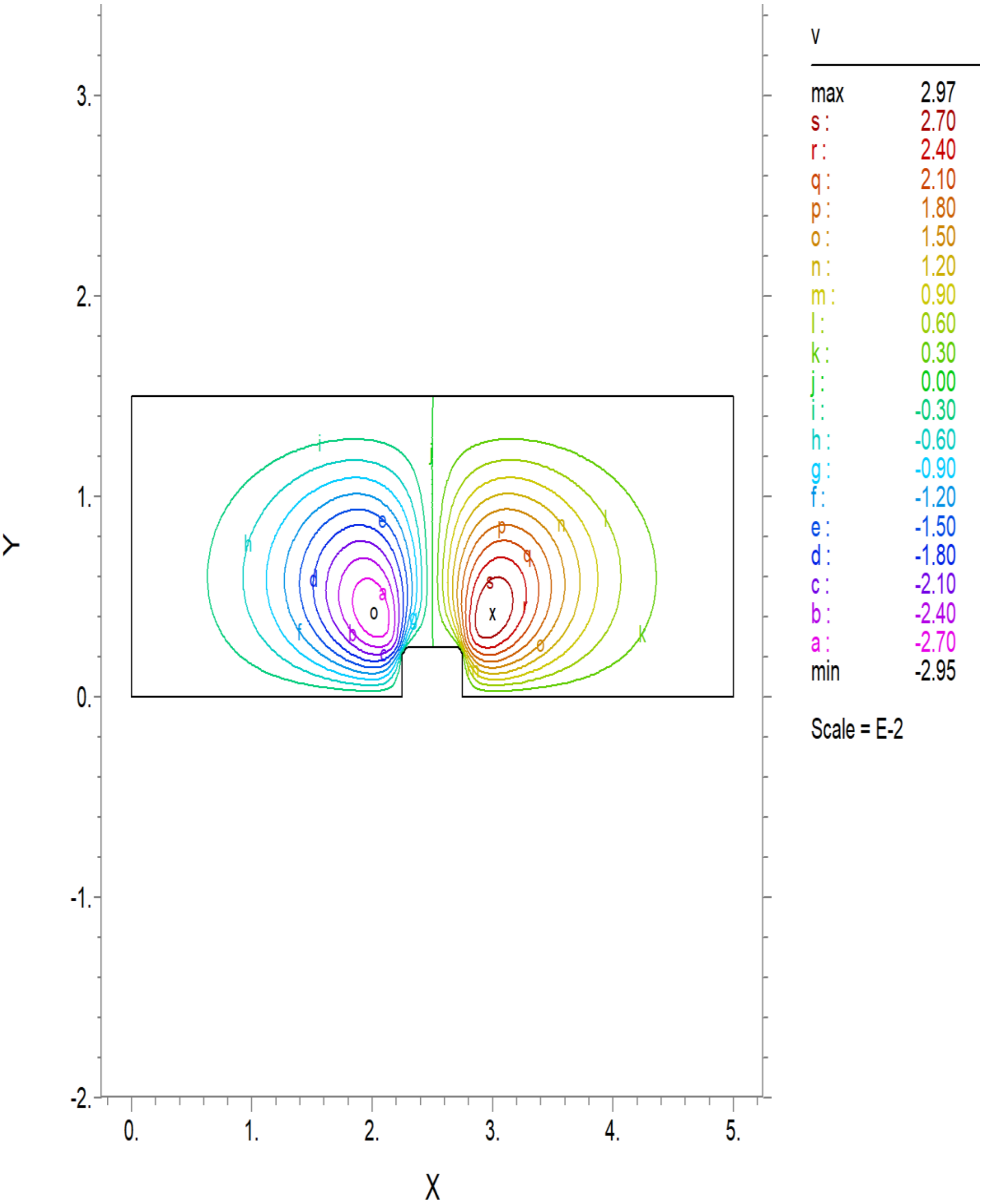

Figure 2. Velocity in Y- Direction

The above Figure depicts the alteration of velocity in vertical direction due to the obstruction in a flow of incompressible and steady fluid

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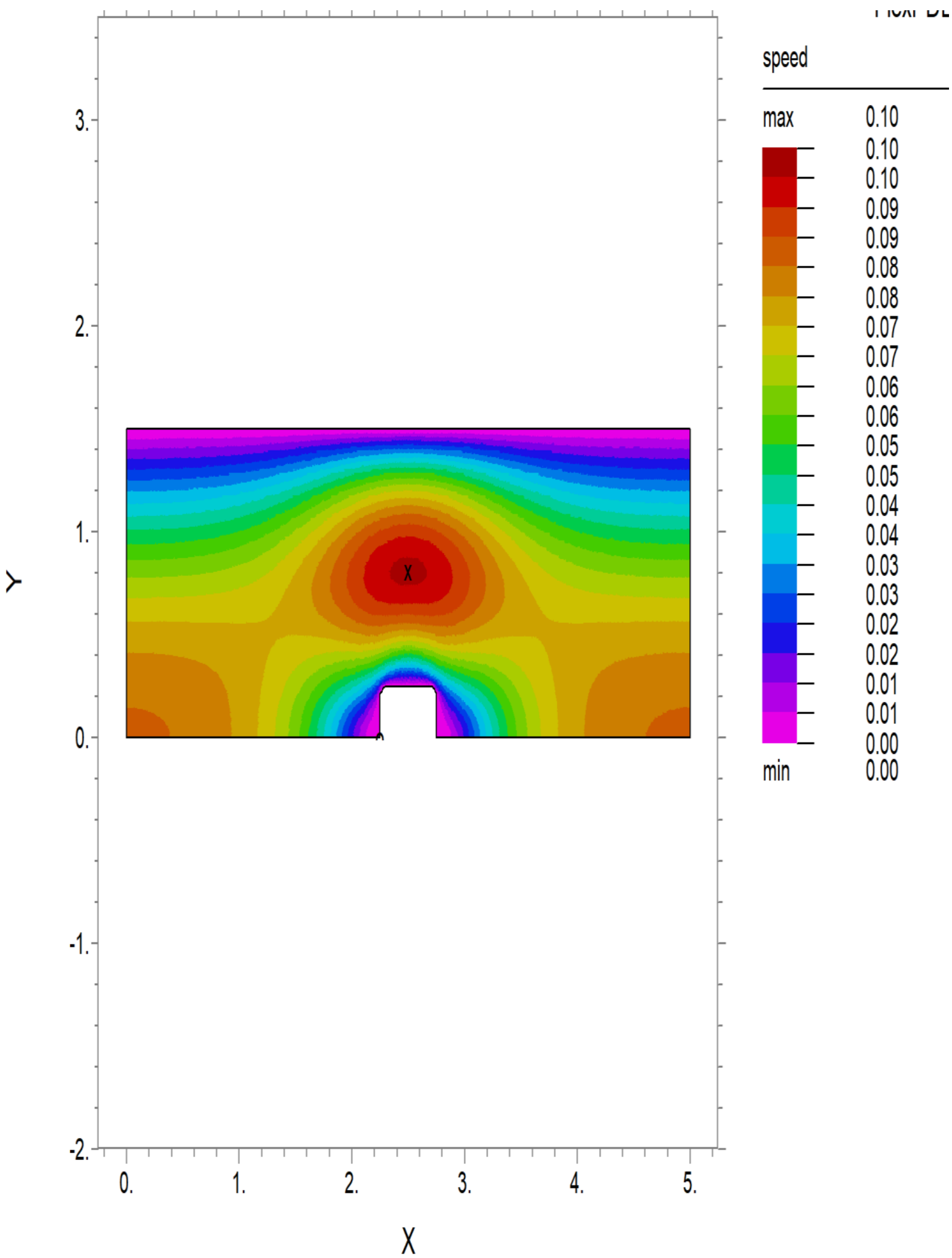

Figure 3. Speed

The alteration in speed is shown in figure 3 for the flow due to an obstruction

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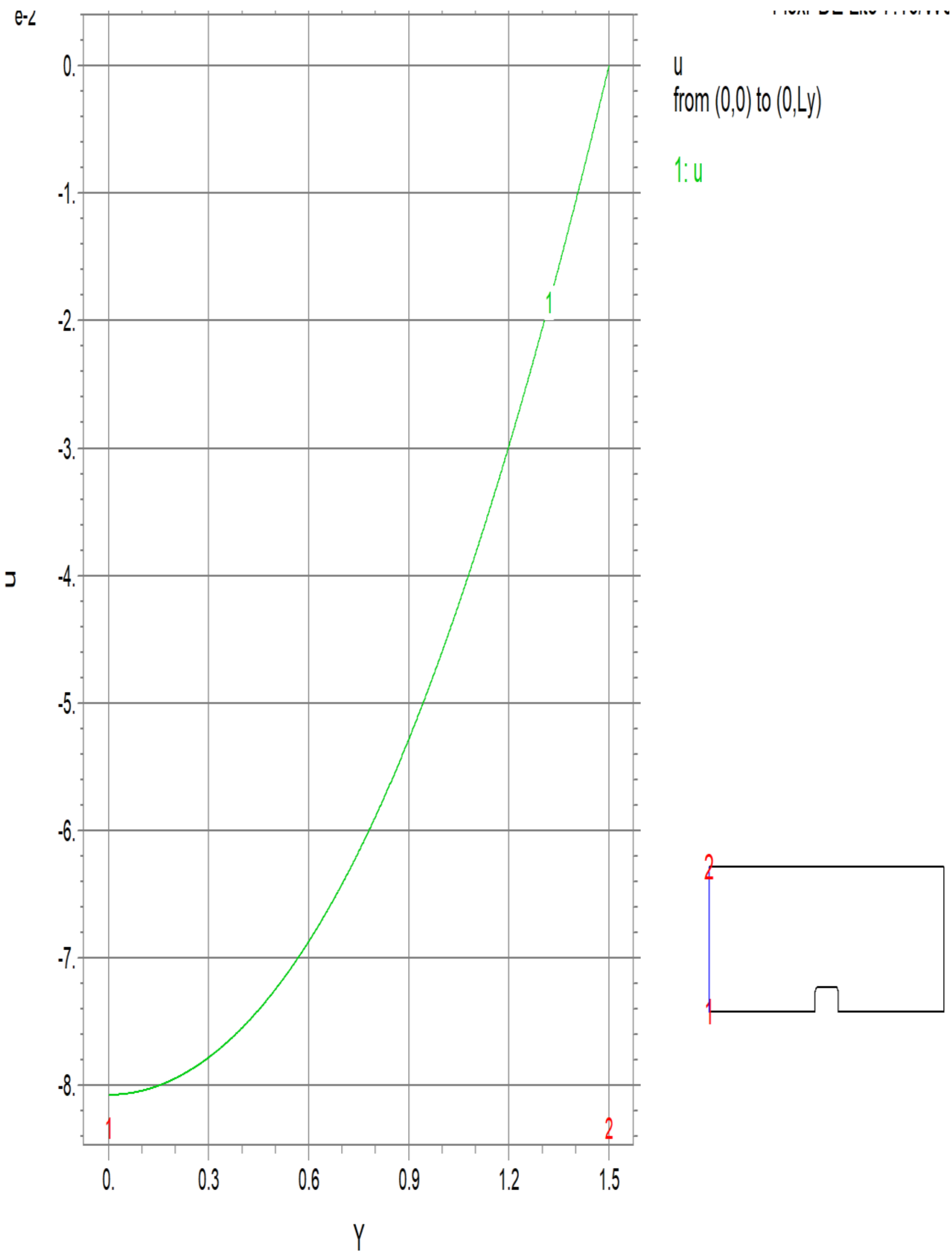

Figure 4. Velocity in horizontal –direction at the inlet

At the inlet of the channel the velocity in horizontal direction from point 1 to point 2 is appearing in the figure 4. The curve shows the values at the different locations

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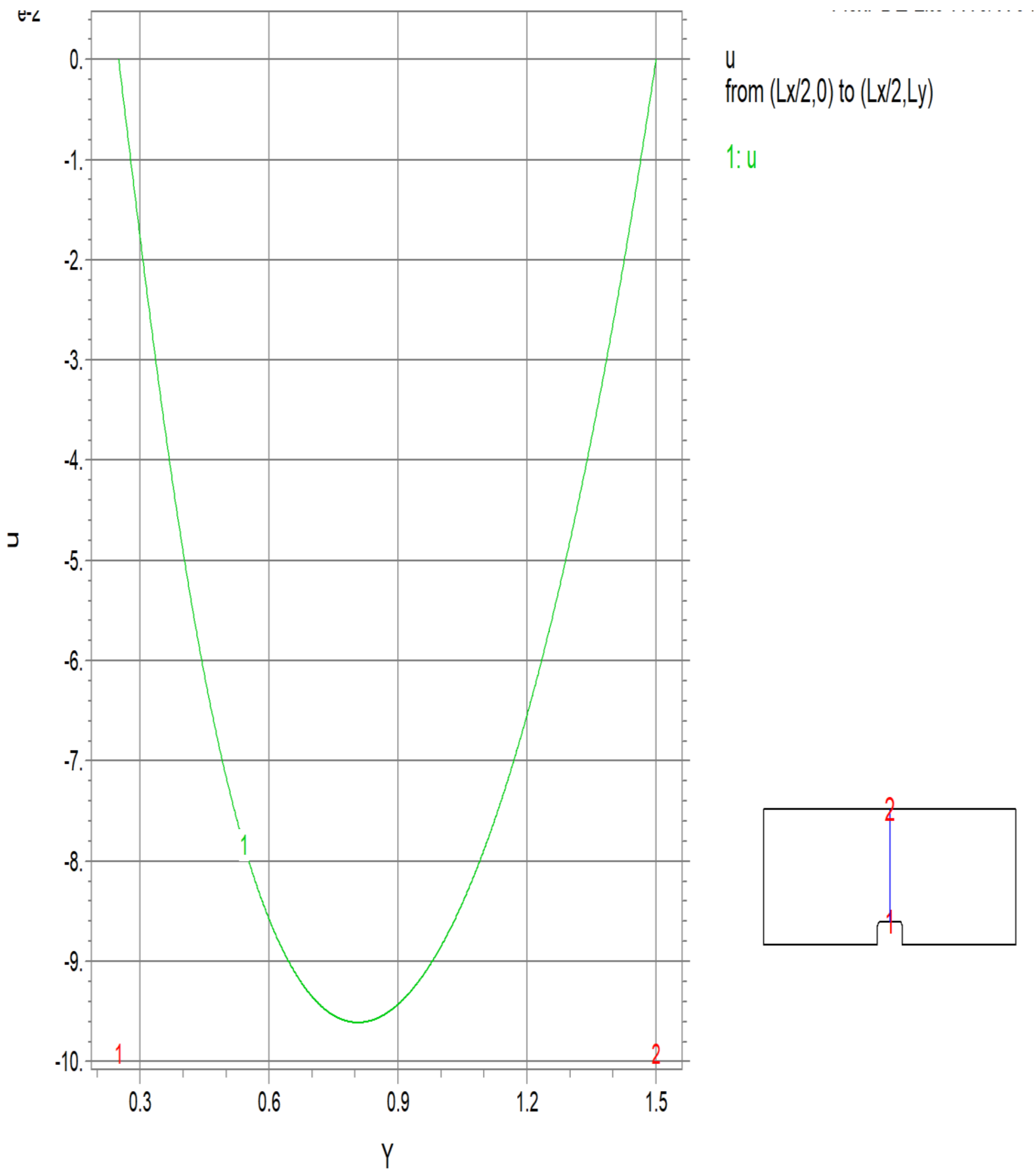

Figure 5. Velocity in X –direction at the Centre

At the center of the channel the velocity in x direction from point 1 to point 2 is appearing in the figure 4. The curve shows the values at the different locations

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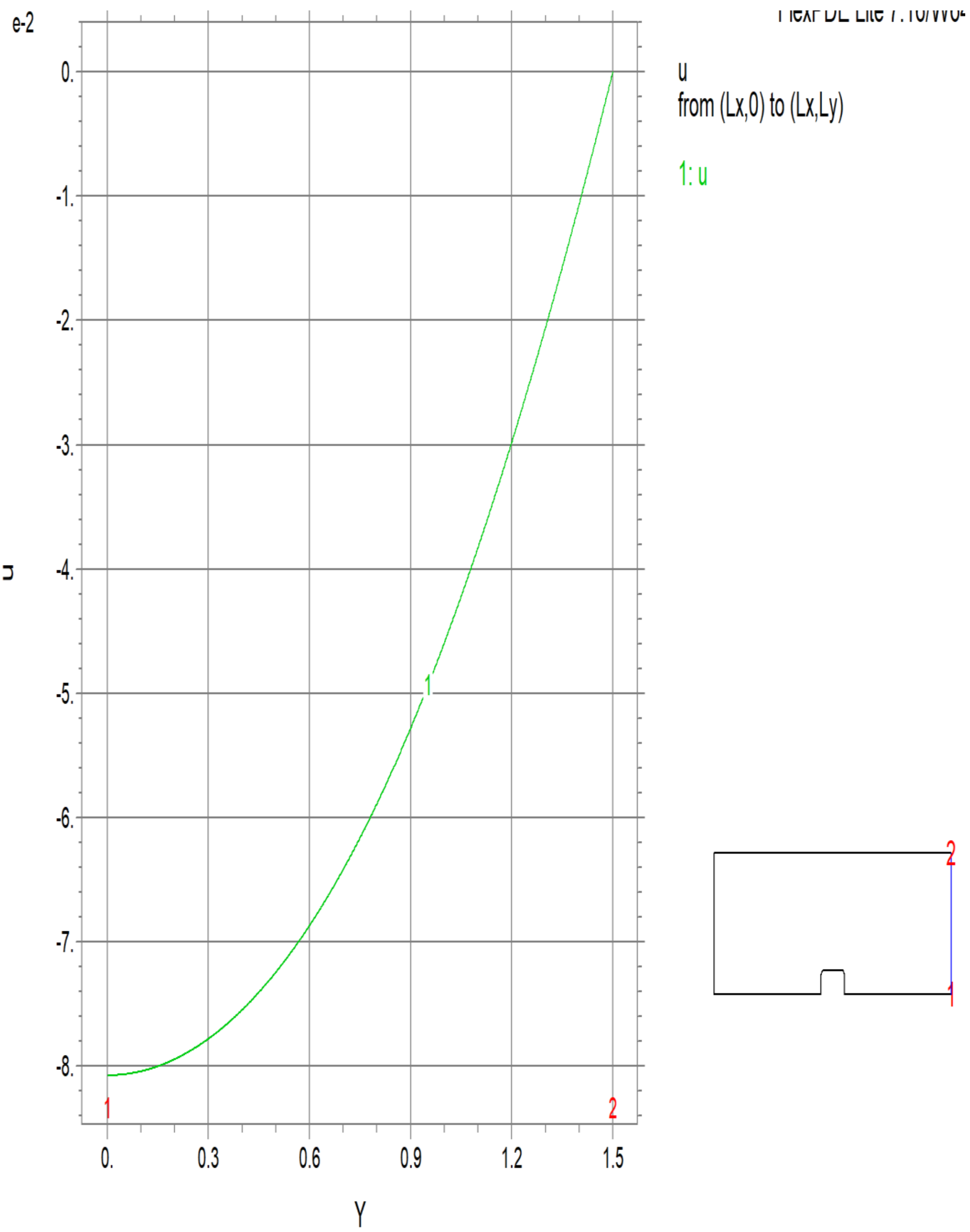

Figure 6. Velocity in X –direction at the outlet

At the outlet of the channel the velocity in x direction from point 1 to point 2 is appearing in the figure 6. The curve shows the data at the different locations

Conclusion

Viscous flow in a two dimensional channel is examined. The variation of velocity in horizontal direction at the inlet, outlet and center are shown with the help of elevation plots. The different plots have been plotted for velocity in x and y direction. The maximum and minimum value for the Reynolds number less than 0.1 has been shown in the plots.

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